

A large, thick black L-shaped graphic is positioned on the left and bottom edges of the slide, framing the central text.

# THE US 40 INDOT COLD IN-PLACE RECYCLING PROJECT

Tuesday March 8, 2016

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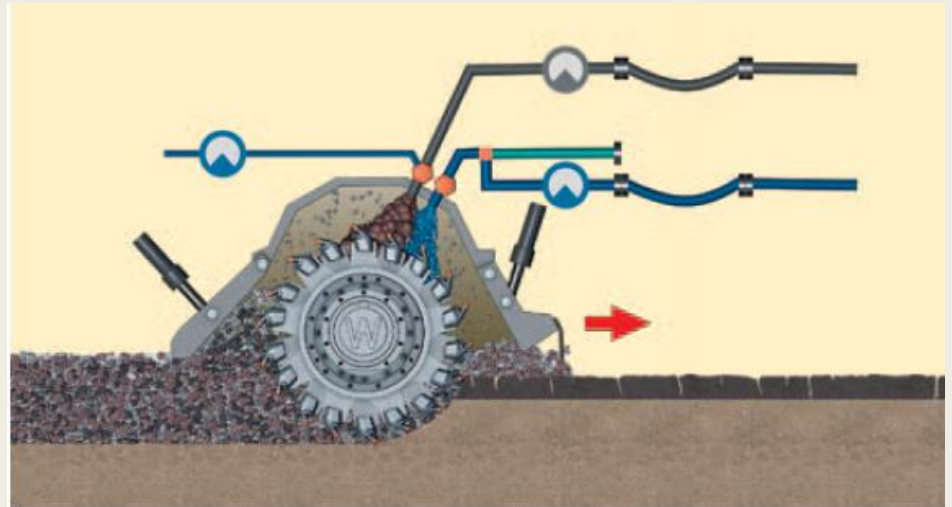
# Outline

- What is CIR?
  - *Equipment*
  - *CIR Candidates*
  - *Project Selection Considerations*
  
- INDOT CIR Experience – US 40
  - *Project Development*
  - *Pretreatment Conditions*
  - *Project Summary*
  - *Lessons Learned*
  - *Moving Forward*



# What is CIR?

- Rehabilitation Method
- 3" – 5" of existing HMA is recycled
- Material is...
  - *Milled and crushed*
  - *Blended with recycling agents*
  - *Paver Laid*
  - *Compacted*



# CIR Train





# CIR Equipment – Single Unit



# CIR Equipment – Single Unit w/ Screed





# CIR Equipment- Multi Unit



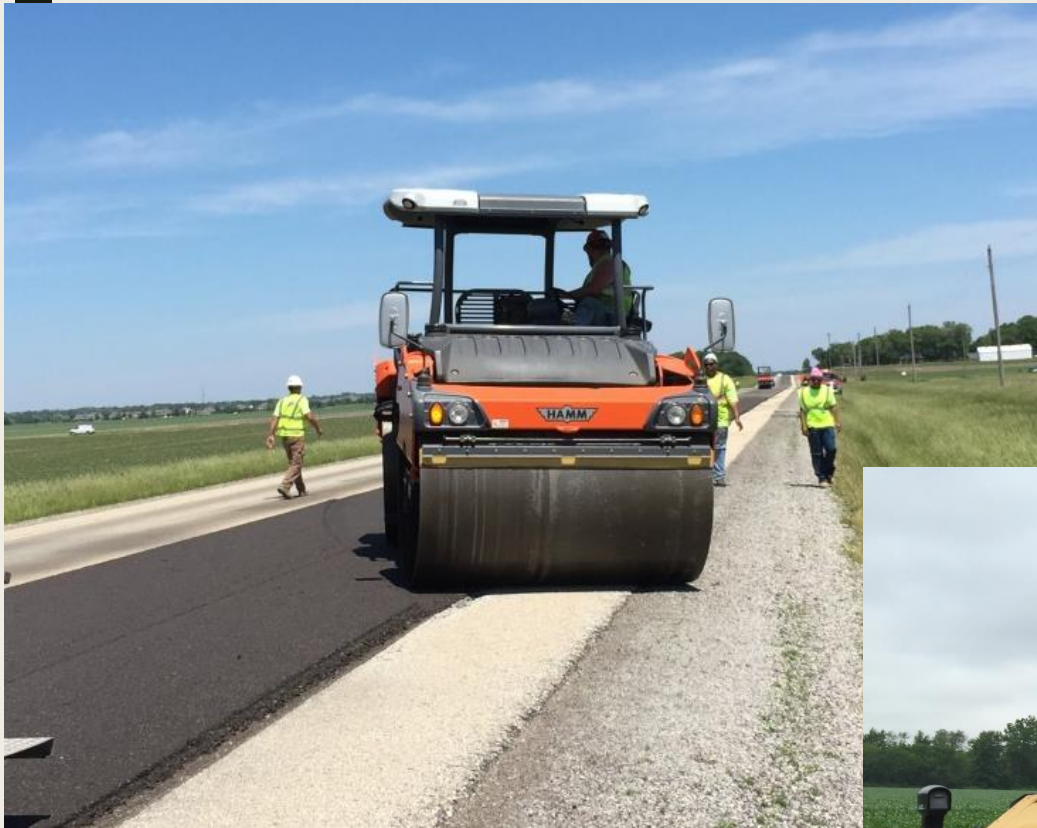
Source: Roadtec

# Paver Laid Material





# Rollers



# Why Cold In-Place Recycling?

- Reuse non-renewable natural resources
- Energy Conservation
- Reduction in User Delays
- Mitigation or Elimination of Cracking
- Improved Roadway Performance
- Cost Savings
  - *Compared to Multiple Lift Mill and Fill Projects*

# CIR Candidates

- Ideal to Address
  - *Raveling*
  - *Reflective Cracking*
  - *Edge and Block Cracking*
  - *Potholes*
  - *Top Down Cracking*
  - *Stripping in Localized Layers*





# CIR Candidates



# CIR Candidates





# CIR Candidates





# CIR Candidates



# How Does CIR Work?

- Project Selection Guidelines
- Performance Based Mix Designs
- Quality Control Guidelines



# CIR Project Selection Guidelines

- CIR Requires Surface Course
- Optimal Construction Season
- Adequate Structural Capacity
  - *~75% Design Strength of HMA*
- Project Logistics
  - *Utilities*
  - *Manholes*
  - *Curb and Gutter*





# CIR Project Selection Guidelines

- Issues to Avoid or of Concern
  - *Widespread Subgrade Failures*
    - CIR will not bridge poor subgrades
    - Localized areas can be repaired then processed
    - Need strong base for compaction
  - *Poor Drainage*
    - CIR needs adequate drainage to perform as designed
  - *Rutting*
    - Shear rutting in existing HMA
    - Need additional aggregate to develop internal strength
  - *Insufficient Structure*
    - Need adequate materials for process
    - Can add aggregate into CIR to increase structure

# CIR Mix Design

- Obtain Cores from Project
- Crush Material
- Recombine to Expected Gradations
- Test at Multiple Emulsion Contents



# Recycling Mix Design Parameters

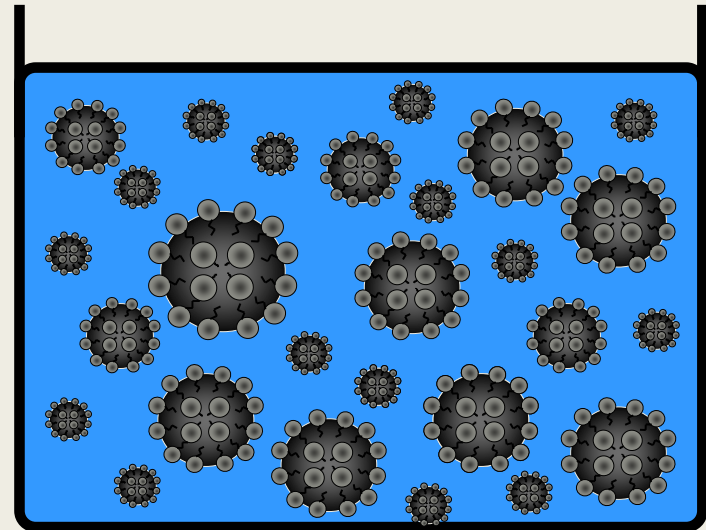
- Which parameters do we investigate for good performance?
  - *Stability*
    - Resistance to rutting
  - *Adhesion*
    - Resistance to water damage
  - *Strength Development*
    - Rate of Development





# What is Asphalt Emulsion?

- Combination of:
  - *Asphalt*
  - *Water*
  - *Surfactants*
- Delivered and mixed at low temperatures
  - *“Cold” Process*
  - *Workability*
- Chemical Break
  - *Formulated to release water*
  - *Gains strength upon break*
  - *Curing*



# CIR Quality Control

- Quality Control is Crucial to Successful Projects!
  - *Density, Density and Density*
  - *Material Yields*
    - Is the correct amount of asphalt going in mixture
  - *In-place Gradations*
    - Adjust emulsion rate based on gradation
  - *Curing Conditions*
    - Need to not trap moisture during surfacing

# Where are we today?

- US 40 CIR Project
  - *Project Recap*
  - *What have we learned*
  - *Moving forward*





# INDOT CIR EXPERIENCE – US 40



- US 40
- West National Rd
  - 9<sup>th</sup> St West Terre Haute
  - I-70 Ramps
- 4 Lane Divided Hwy
- New Bridges
- Transfer to Vigo County

# INDOT CIR Experience – US 40

- US 40 CIR
  - *Composite Pavement*
  - *~4 inches HMA*
  - *Alternate Bid Project*
  - *Mill and Fill vs CIR and HMA overlay*



# INDOT CIR Experience – US 40

- *Estimated 350K less than mill and fill option*
- *CIR bid cost: \$8.25/ sq. yd.*
  - 4 inch CIR
  - 1.2 gal/sq. yd.
- *CIR area: 97,404 sq. yd.*
- *165 lbs./ sq.yd.  
9.5 mm HMA  
Surface*





# US 40 – Preconstruction Conditions



# US 40 – Preconstruction Conditions



- Aged surface
- Minor rutting
- Heavy patching due to stripped HMA layer
- Chip Seal in Rural Section

# INDOT CIR Experience - US 40

- Stripping in lowest lift of HMA





# INDOT CIR Experience – US 40



CIR Core with Overlay vs. Existing Pavement

# INDOT CIR Experience – US 40

## ■ Timeline

- *Original CIR started on September 19, 2014*
- *West Bound Lanes and In-town Section Completed October 2014*
  - Portion of section had to be reprocessed
- *Eastbound Lanes completed August 2015*
- *Reprocessed Lane completed August 2015*

# INDOT CIR Experience – US 40



Compacting WB CIR 2014



# INDOT CIR Experience – US 40



Completed CIR Mat WB Driving Lane 2014

# INDOT CIR Experience – US 40

- 2014 Challenges on US 40
  - *Equipment Issues*
    - CIR machine was down for several working days
    - Meter on CIR machine failed
      - *Resulted in under asphalted section to be reprocessed*
      - *Stabilizer needs to be a separate pay item*
  - *Late Season Weather*
    - Equipment delays pushed project into less than ideal recycling climate
    - Excessive Rain
      - *Resulted in wet subgrade and failures in shoulders*
      - *Repair areas that could not set up before heavy rainfall*

# INDOT CIR Experience – US 40

- Shoulders consisted of 4 in. HMA on subgrade
- Fall 2014 processing multiple shoulder failures
- Summer 2015 one shoulder failure
  - *Low, shaded area along outside shoulder*





# INDOT CIR Experience – US 40



Reprocessing 2014 Low Emulsion Area

# INDOT CIR Experience – US 40



Processed Lane versus Existing US 40



# INDOT CIR Experience – US 40



March 2015 WB Ramp to I70



# INDOT CIR Experience – US 40



December 2015 WB Lanes

# INDOT CIR Experience – US 40



December 2015 EB Lanes

# INDOT CIR Experience – US 40

## ■ Lessons Learned

- *Timing of the CIR process*
- *Importance of Quality Control*
- *Need to refine Specifications*
  - Smoothness for CIR different than HMA
  - Should we include profile milling with single lift overlays?
  - Desired cross slope
- *How to address shoulders*
  - Subgrade failures in the shoulders



# CIR Moving Forward

- Specification Development
  - *Collaborative Effort between INDOT & Industry*
  - *Similar to FDR Specification Development*

# Thank you!

- Questions and Comments

